Owl Creek Restoration Project

Hydraulic Analysis and Data Summary Report

Owl Creek

Submitted To:

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Executive Summary

River Design Group, Inc. (RDG) has been retained by the Swan Ecosystem Center (SEC), in cooperation with the U.S. Fish and Wildlife Service (FWS) and landowner, to develop a restoration plan for a 0.4 mile reach of Owl Creek in Missoula County near Condon, Montana. In support of this restoration plan and to gain a better understanding of site hydrology, a data collection effort was completed at five sites in the project area. Three sites were located on the main stem Owl Creek and two sites were located on tributaries that enter the restoration project area.

At each of the five sites, discharge measurements were completed to calculate the stream flow observed at the time of the field survey. The channel cross-sections and the local water surface slope were surveyed using a survey-grade GPS and Topcon GTS 312 Total Station. Wolman pebble counts were completed to determine the substrate particle size distribution and channel roughness. This information was utilized to model bankfull or effective discharge at each of the five surveyed sites. Established resistance equations such as Manning's, Relative Roughness, Darcy-Weisbach and U/U* were applied.

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1 Owl Creek and Tributary 2

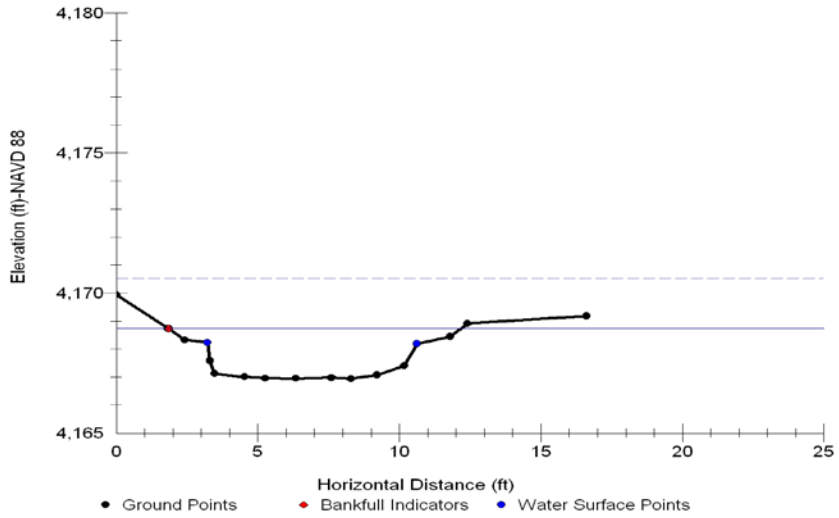

Figure 1-1. Hydraulic cross-section for Owl Creek and Tributary 2.

Table 1-1. Owl Creek and Tributary 2 cross-section summary data.

Metric	Result
Channel Slope (ft/ft)	0.0043
Bankfull Width (ft)	10.3
Mean Depth (ft)	1.3
Bankfull Area (sq ft)	13.2
Wetted Perimeter (ft)	12.0
Hydraulic Radius (ft)	1.1
Measured Discharge (cfs)	21.5
Modeled Discharge (cfs)	20.9

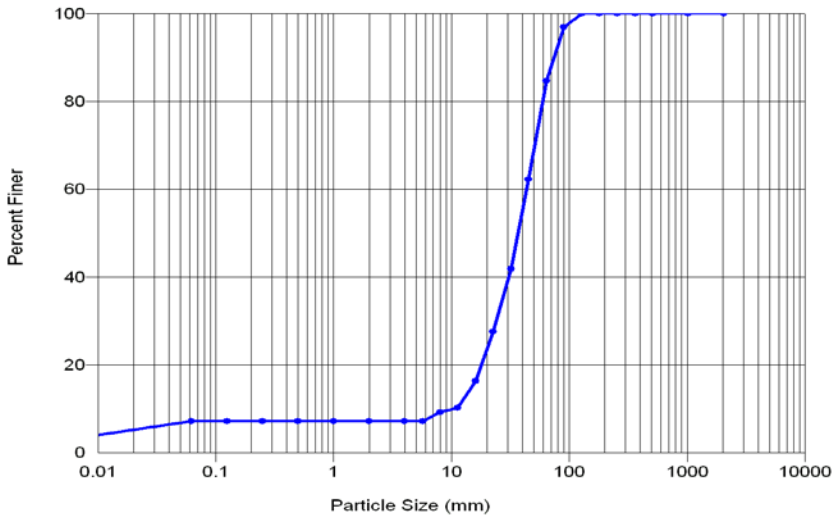

Figure 1-2. Substrate particle size distribution for Owl Creek and Tributary 2.

Table 1-2. Substrate particle size distribution for Owl Creek and Tributary 2.

Metric	Millimeters	Inches
D16	16	0.6
D35	28	1.1
D50	37	1.5
D84	63	2.5
D95	86	3.4
D100	128	5.0

Table 1-3. Estimated bankfull discharge (cfs) for Owl Creek and Tributary 2.

XS ID	Manning's	Relative Roughness	Darcy-Weisbach	U/U*	Average
Owl Creek and Tributary 2	38.2	35.9	38.1	35.5	36.9

2 Tributary 3

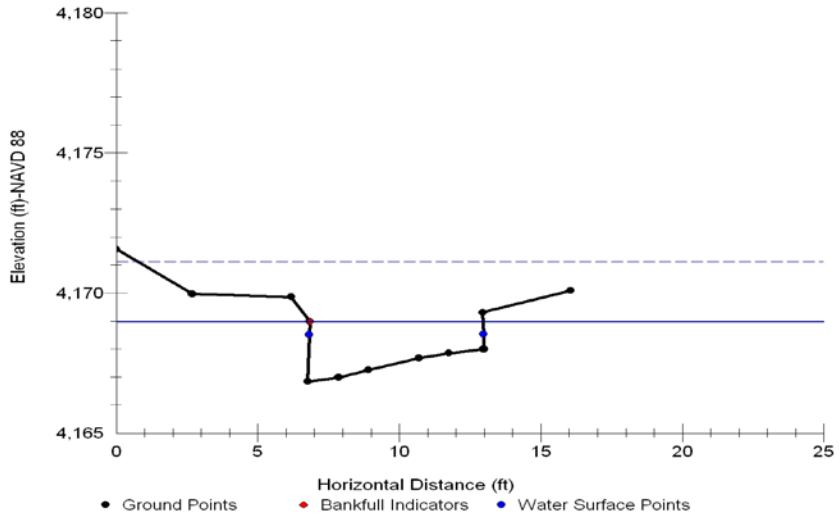

Figure 2-1. Hydraulic cross-section of Tributary 3.

Table 2-1. Tributary 3 cross-section summary data.

Metric	Result
Channel Slope (ft/ft)	0.0035
Bankfull Width (ft)	6.1
Mean Depth (ft)	1.5
Bankfull Area (sq ft)	9.4
Wetted Perimeter (ft)	9.5
Hydraulic Radius (ft)	1.0
Measured Discharge (cfs)	6.3
Modeled Discharge (cfs)	7.0

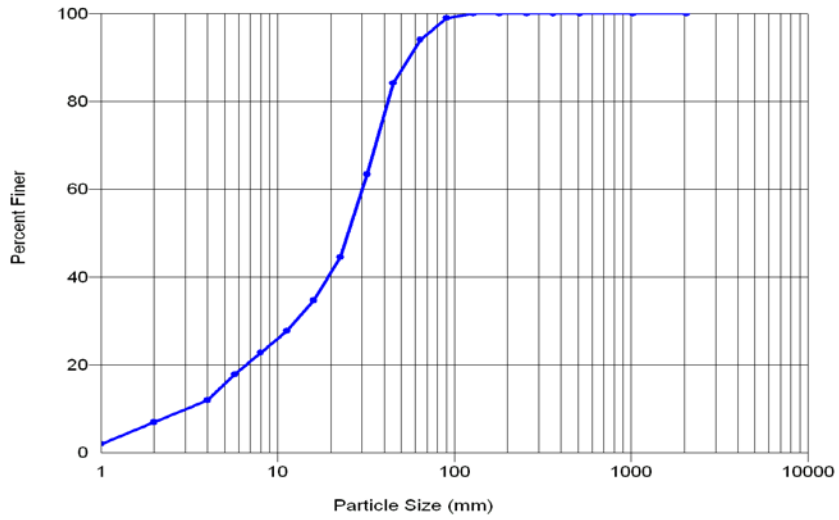

Figure 2-2. Substrate Particle size distribution for Tributary 3.

Table 2-2. Substrate particle size distribution for Tributary 3.

Metric	Millimeters	Inches
D16	5	0.2
D35	16	0.6
D50	25	1.0
D84	45	1.8
D95	69	2.7
D100	128	5.0

Table 2-3. Estimated bankfull discharge (cfs) for Tributary 3.

XS ID	Manning's	Relative Roughness	Darcy-Weisbach	U/U*	Average
Tributary 3	12.8	20.1	23.4	20.7	19.3

3 Owl Creek and Tributaries 2 and 3

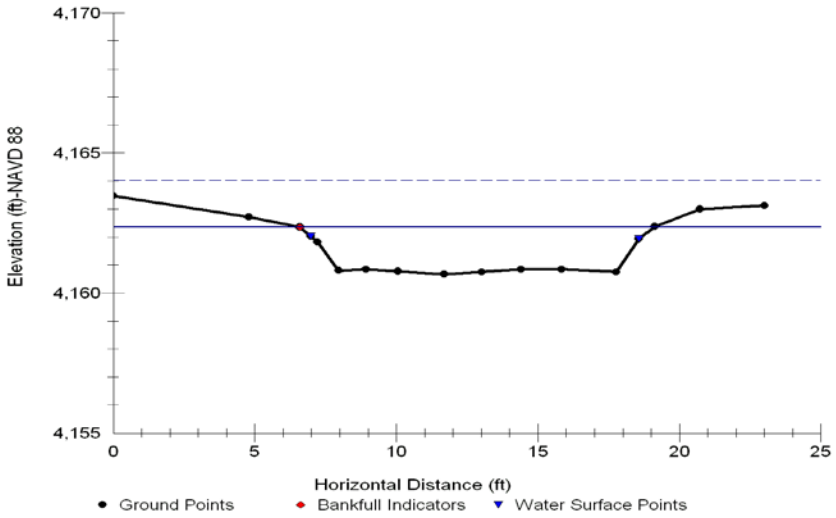

Figure 3-1. Hydraulic cross-section of Owl Creek and Tributaries 2 and 3.

Table 3-1. Owl Creek and Tributaries 2 and 3 cross-section summary data.

Metric	Result
Channel Slope (ft/ft)	0.0037
Bankfull Width (ft)	12.5
Mean Depth (ft)	1.4
Bankfull Area (sq ft)	17.2
Wetted Perimeter (ft)	14.0
Hydraulic Radius (ft)	1.2
Measured Discharge (cfs)	27.0
Modeled Discharge (cfs)	28.4

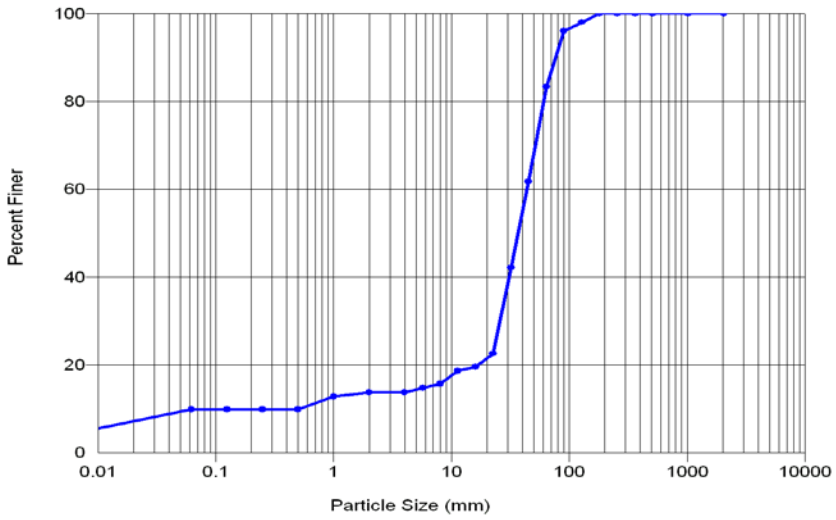

Figure 3-2. Substrate Particle size distribution for Owl Creek and Tributaries 2 and 3.

Table 3-2. Substrate particle size distribution for Owl Creek and Tributaries 2 and 3.

Metric	Millimeters	Inches
D16	8	0.3
D35	29	1.1
D50	37	1.5
D84	65	2.6
D95	88	3.7
D100	180	7.1

Table 3-3. Estimated bankfull discharge (cfs) for Owl Creek and Tributaries 2 and 3.

XS ID	Manning's	Relative Roughness	Darcy-Weisbach	U/U*	Average
Owl Creek and Tributaries 2 and 3	50.6	47.6	49.9	47.0	48.8

4 Tributary 4

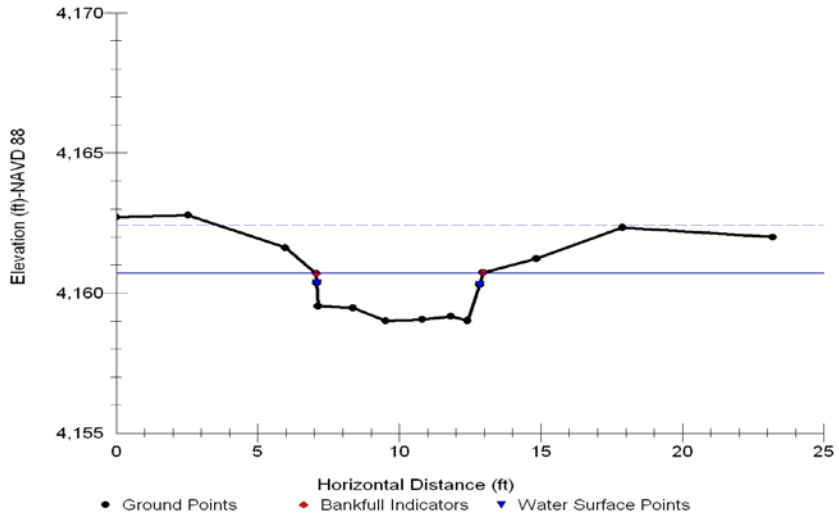

Figure 4-1. Tributary 4 hydraulic cross-section.

Table 4-1. Tributary 4 cross-section summary data.

Metric	Result
Channel Slope (ft/ft)	0.0016
Bankfull Width (ft)	5.9
Mean Depth (ft)	1.4
Bankfull Area (sq ft)	8.5
Wetted Perimeter (ft)	8.4
Hydraulic Radius (ft)	1.0
Measured Discharge (cfs)	2.7
Modeled Discharge (cfs)	4.9

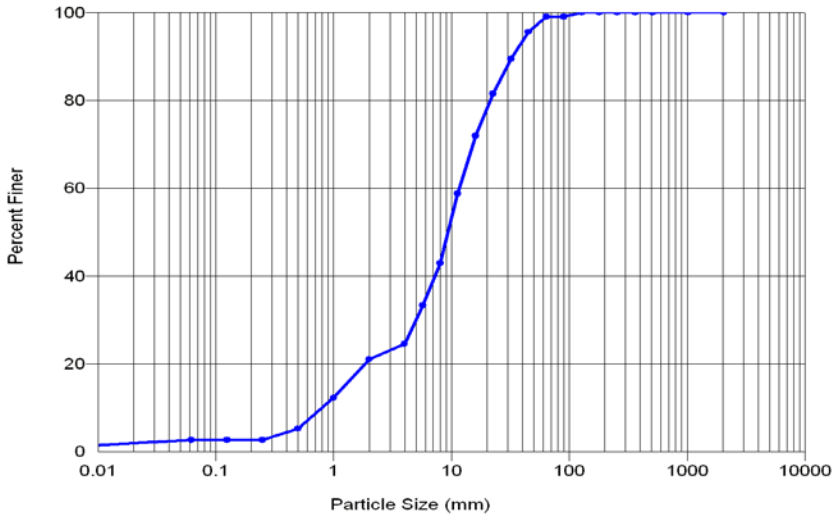

Figure 4-2. Substrate particle size distribution for Tributary 4.

Table 4-2. Substrate particle size distribution for Tributary 4.

Metric	Millimeters	Inches
D16	1	0.04
D35	6	0.2
D50	9	0.4
D84	25	1.0
D95	44	1.7
D100	128	5.0

Table 4-3. Estimated bankfull discharge (cfs) for Tributary 4.

XS ID	Manning's	Relative Roughness	Darcy-Weisbach	U/U*	Average
Tributary 4	17.9	16.6	18.4	16.7	17.4

5 Owl Creek Downstream of the Project Area

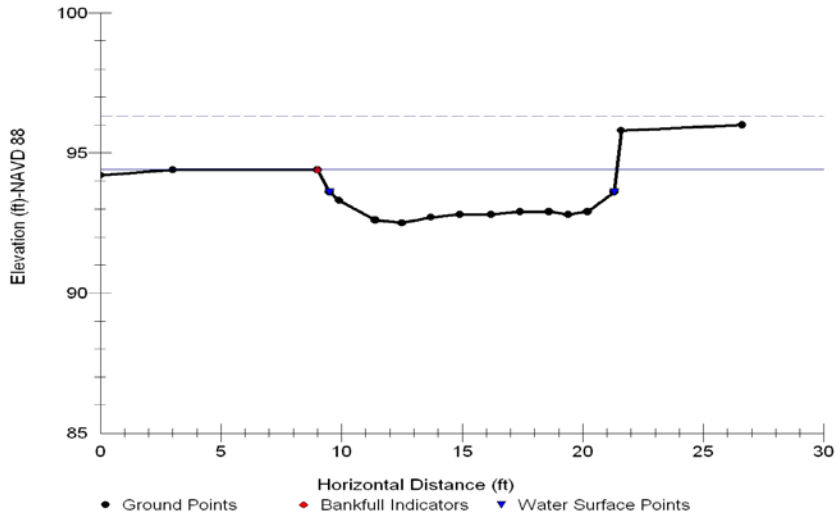

Figure 5-1. Hydraulic cross-section of Owl Creek downstream of the project area.

Table 5-1. Owl Creek cross-section summary data.

Metric	Result
Channel Slope (ft/ft)	0.0064
Bankfull Width (ft)	12.4
Mean Depth (ft)	1.5
Bankfull Area (sq ft)	18.5
Wetted Perimeter (ft)	14.1
Hydraulic Radius (ft)	1.3
Measured Discharge (cfs)	28.9
Modeled Discharge (cfs)	27.4

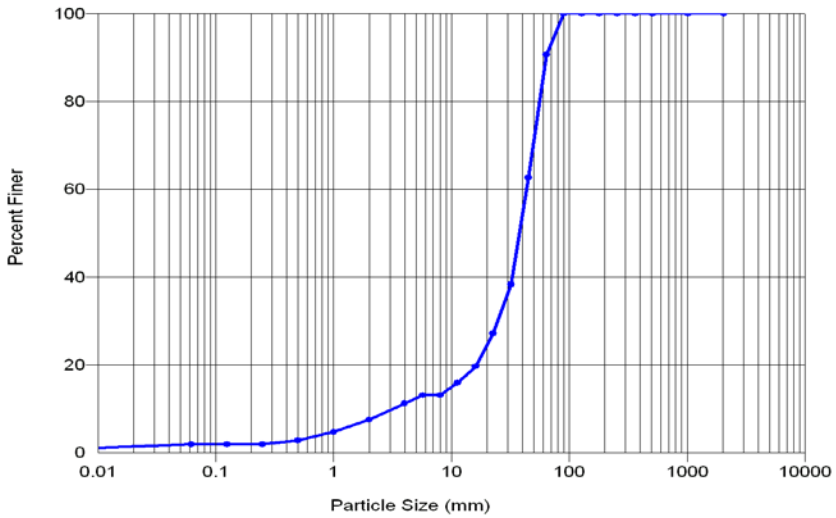

Figure 5-2. Substrate particle size distribution for Owl Creek downstream of the project area.

Table 5-2. Substrate particle size distribution for Owl Creek downstream of the project area.

Metric	Millimeters	Inches
D16	11	0.4
D35	29	1.1
D50	38	1.5
D84	59	2.3
D95	76	3.0
D100	90	3.5

Table 5-3. Estimated bankfull discharge (cfs) for Owl Creek downstream of the project area.

XS ID	Manning's	Relative Roughness	Darcy-Weisbach	U/U*	Average
Owl Creek	76.5	72.2	76.0	72.5	74.3

6 Hydraulic Analysis Summary

Table 6-1. Hydraulic analysis summary for measured and modeled discharges (cfs).

XS ID	Measured Discharge	Modeled Discharge	Estimated Bankfull Discharge
Owl Creek and Tributary 2	21.5	20.9	36.9
Tributary 3	6.3	7.0	19.3
Total	27.8	27.9	56.2
Owl Creek and Tributaries 2 and 3	27.0	28.4	48.8
Tributary 4	2.7	4.9	17.4
Total	29.7	33.3	66.2
Owl Creek Downstream of the Project Area	28.9	27.4	74.3